



Aquatic Invasive Species and the Great Lakes: GLERL's Program and Action Plan

"Invasive species are everywhere. They damage our crops, our industries, the environment and public health. Scientists, academics, leaders of industry and land managers are realizing that invasive species are one of the most serious environmental threats of the 21st century." -- (*Meeting the Invasive Species Challenge*, National Invasive Species Council, January 2001).

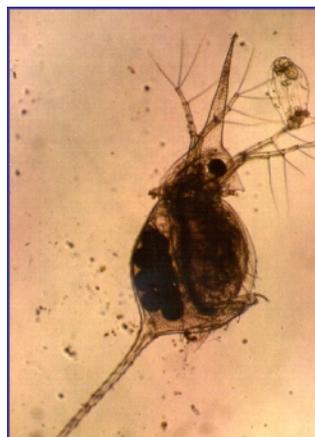
A Costly National Problem

The national awareness of aquatic invasive species and the problems they cause arose primarily from the costly unintentional introduction of the zebra mussel in the Great Lakes in the late 1980s and its subsequent spread throughout the eastern half of the country.

- The costs for treatment against zebra mussels in the Great Lakes alone are estimated at ~\$30M/yr.
- Control treatment for the sea lamprey in the Great Lakes basin costs the about \$15M/yr.
- The annual economic costs of invasive species to the U.S. economy are estimated to be in the billions.

Present Status – Great Lakes Aquatic Nuisance Species

- A 1993 study identified 139 established nonindigenous species in the Great Lakes. Of these, 56 were identified as aquatic species.
- Since then at least six additional aquatic species have been identified in the Lakes (see table below), bringing the number to at least 145.
- Also, in 1993, the U.S. implemented mandatory ballast exchange/treatment requirements for most vessels entering the Great Lakes.
- At least two of the additional species were likely introduced after the implementation of mandatory ballast water exchange in 1993, probably via ballast tank discharges (*Echinogammarus* and *Cercopagis*).
- In the last 15 years, 7 out of 12 introduced aquatic species have been natives of the Caspian Sea - Black Sea area of Eurasia (Ponto-Caspian basins).



Daphnia lumholtzi, a small zooplankton native to Australia, Africa, and southeast Asia, is the latest nonindigenous species to be confirmed in the Great Lakes (2000).

Probable method of introduction: recreational boating and fishing.

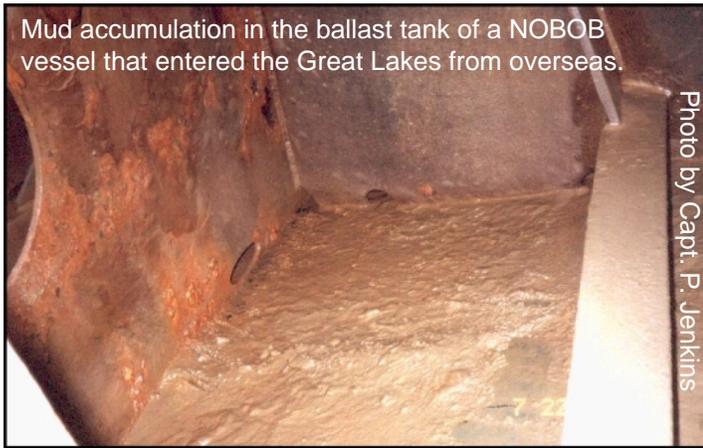
- The Baltic Sea appears to be the primary donor region of Ponto-Caspian species found in the Great Lakes.
- Coast Guard statistics reveal that >75% of the vessels entering the Lakes since 1993 have declared no-ballast-on-board (NOBOB), and have thus been exempt from ballast exchange or any other scrutiny.
- The tanks of NOBOB vessels can contain residual water and sediment accumulated from repeated ballasting operations.
- These residuals can contain a wide assortment of plants, animals, and microorganisms, including so-called "resting stages" (cysts, ehippia, resting eggs, or spores).
- The NOBOB issue has risen from one of relative obscurity in the 1990s to become one of the leading concerns in the Great Lakes region today.



Resting eggs found in mud collected from ballast tank of a transoceanic "NOBOB" vessel in the Great Lakes, December 2000.

Additional Nonindigenous Aquatic Species Identified Since 1993

Species	Common Name	Native Area	~ Year of Entry	Likely Pathway	Likely Donor Region
<i>Thalassiosira baltica</i>	diatom	Europe	1988	Ballast Tank	Europe
<i>Potamopyrgus antipodarum</i>	New Zealand mud snail	New Zealand	1991	Ballast Tank	Baltic Sea
<i>Echinogammarus ischnus</i>	amphipod	Ponto-Caspian	1994	Ballast Tank	Baltic Sea
<i>Alosa aestivalis</i>	blueback herring	Atlantic	1995	Canals	NE Atlantic
<i>Cercopagis pengoi</i>	Fish-hook waterflea	Ponto-Caspian	1998	Ballast Tank	Baltic Sea
<i>Daphnia lumholtzi</i>	Waterflea	Australia, Africa, SE Asia	2000	Recreational Boating	Central US



What GLERL has been doing

GLERL began its invasive species research program in the late 1980s and conducted field- and laboratory-based projects throughout the 1990s focused on the ecosystem effects of the zebra mussel:

- the impacts of the zebra mussel invasion on Saginaw Bay.
- the resurgence of summer blue-green algae blooms in western Lake Erie and Saginaw Bay.
- the disappearance of the benthic amphipod *Diporeia* spp. from southern Lake Michigan, implicating zebra mussels as the causative agent.

In the late 1990s the Great Lakes Panel on Aquatic Nuisance Species adopted policy positions and priorities for ballast water research. The three top research priorities identified are:

- Evaluation of ballast water exchange.
- Addressing vessels with no ballast on board (NOBOB).
- Biocide studies.

In 2000 GLERL's nonindigenous species program was expanded in response to Panel priorities and new projects were initiated with funding from the U.S. Coast Guard, U.S. EPA (Great Lakes National Program Office), NOAA Headquarters, NOAA's National Sea Grant Program Office, the Great Lakes Fishery Trust Fund, and the Great Lakes Protection Fund, to:

1. Characterize and assess the biota in the "empty" ballast tanks of no-ballast-on-board (NOBOB) vessels.
2. Experimentally evaluate the effectiveness of ballast water exchange in reducing the risk of new introductions.
3. Determine the effectiveness of certain biocides for treatment of ballast water and ballast tanks.

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A National Action Plan

GLERL proposed a new invasive species program that integrates research, monitoring, assessment, international cooperation, program coordination, and education to strengthen our ability to work in meaningful and proactive partnership with other federal, state, local and international entities, and the public. The specific elements of this plan are:

Improved Scientific Basis for Aquatic Species Invasion Prevention, Control and Mitigation

- support and conduct research on ballast water and ballast tanks (NOBOBs).
- assess the effectiveness of alternative prevention and management techniques.
- identify and assess key invasion pathways and vectors, and high-risk taxa that pose the most significant threat.
- conduct research to document and understand the effects aquatic invasions on key coastal resources and ecosystems.

Monitor Coastal Ecosystems for New Invasions

- work with other federal, state, local and non-government interests to establish and coordinate experimental monitoring.
- incorporate database networking with national and international groups.

Develop Scientific and Technological Collaborations with International Partners

- support collaborative research planning and sharing of scientific information with foreign scientists.
- develop joint projects.

Coordinate NOAA's Response to the Aquatic Species Invasions

- establish a handful of NOAA regional coordinators to coordinate invasive species actions with other organizations regionally and nationally.

Develop Public Education Programs

- develop education & outreach information programs.

Dikerogammarus villosus, a small freshwater amphipod native to the Ponto-Caspian region of Eurasia has been identified as another invasive species that is spreading through Europe and poses a serious threat to the Great Lakes.



(Photo from S. Giesen, 1998)